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On Goodness of Models and Instantiations in Design Research: Some Potential Perspectives

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Abstract. In this paper, we discuss how to evaluate (models and instantiations), which criteria for goodness that are applicable within different research approaches. In the prevalent (positivist) research we are accustomed to ask whether a certain model truthfully describes an object under study, and how useful is a new IT artifact. But researchers can also take other perspectives than the prevalent one on the world, e.g., interpretive or critical. In addition to models, researchers can also evaluate a wider information system than the new IT artifact only. We restrict our consideration into design research, the models developed and the outcomes constructed. We must model the old system in the problem space and the new system in the solution space. We therefore collect and analyze various guidelines for modeling from different perspectives (positivist, interpretive and critical). Concerning design outcomes we pay attention to different stake holder groups and their different evaluation criteria.

Keywords: Perspectives, Positivist, Interpretive, Critical, Design research, Models, Instantiations.

1 Introduction

This Referring to the debate around the rigor and relevance of Information Systems (IS) research also Constantinides et al. [9] (as we) very recently paid attention to the ends of IS research. They "argue that any effort to understand the state of the Information Systems field has to view IS research as a series of normative choices and value judgments about the *ends of research* (cursive added) [9:1]. To assist a systematic questioning of the various ends of IS research, we propose a pragmatic framework that explores the choices IS researchers make around theories and methodologies, ethical methods of conduct, desirable outcomes, and the long-term impact of the research beyond a single site and topic area." They illustrate their framework by considering and questioning the explicit and implicit choices of topics, design and execution, and the representation of knowledge in experimental research — research often considered to be largely beyond value judgments and power relations.

In addition to those general reasons presented by Constantinides et al. [9] we selected the goodness of models and instantiations in design research as research topic for private reasons, i.e., as a supervisor of doctoral candidates coming from industry.

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When they are studying their own work their topic is relevant and publishing in scientific journal will implicitly take care of rigor. What we as a supervisor must then do is to present them how the IS community evaluates the IS research. To this end, we like in this paper find out *how the IS community is guiding the IS research and/or which criteria are recommended to be used in IS studies*.

Instead of considering experimental research as Constantinides et al. [9] do, we shall concentrate design research, especially models and instatntiations in that context. We shall exclude constructs (cf. March and Smith [29]) from our consideration because we then should analyze three approaches: the variance, process and systems approaches [4]. The three approaches can be taken as super-eyeglasses and an object of study will then be seen either as variables and their relationships (variance), or events and their sequences (process) or wholes, parts and their interactions (systems), respectively. This would enlarge our consideration threefold.

Our second restriction is to exclude methods. Here we have two reasons. Firstly, according to van Aken [38] design knowledge concerns three designs: an object-design, a realization-design, and a process-design. Both the realization and process designs concern methods. Second, there are both descriptive and prescriptive methods. The descriptive methods describe how the problem was solved. The logic of a prescription is if you want to achieve Y in situation Z, then perform action X. Inclusion of methods into our consideration would increase our analysis many fold.
March and Smith [29:258] state that "research activities in design science are twofold: build and evaluate. Build refers to the construction of the artifact, demonstrating that such an artifact *can* be constructed. Evaluate refers to the development of criteria and the assessment of artifact performance against those criteria.

We *evaluate* artifacts to determine if we have made any progress. The basic question is, how well does it work? Recall that progress is achieved when a technology is replaced by more effective one. Evaluation requires the development of metrics and the measurement of artifacts according to those metrics. Metrics define what we are trying to accomplish. They are used to assess the performance of an artifact. Lack of metrics and failure to measure artifact performance according to established criteria results in an inability to effectively judge research efforts." If "an *instantiation* is the realization of an artifact in its environment" (March and Smith [29:258]) then, to our mind, the description above mainly concerns IT artifacts, not models in design research.

According to March and Smith [29:256], "a *model* is a set of propositions or statements expressing relationships among constructs. In design activities, models represent situations as problem and solution statements." Hence we shall in design research have two or three models: 1) a model of the initial state, 2) a model of the desired state and 3) the model of the finished, realized state. The two last ones can be identical, if the realization was successful, but the final state is often "less" or "more" than desired.

March and Smith [29] give some goodness criteria, e.g., their fidelity with real world phenomena, completeness, level of detail, robustness, and internal consistency for models and the efficiency and effectiveness of the artifact, and its impacts on the environment and its users for instantiations, but they do not tell from which stake

holder group their criteria are given. We guess that some of those criteria are given from the group of researchers and some other mainly from the group of managers.

Concerning the design process and its outcomes, there are at least three stake holder groups: managers, designers and customers (cf. Reeves and Bednar [35]), and they have different perspectives on the artifact or innovation designed, and therefore different goodness criteria, too. But a researcher can also take one of the many possible world views or (scientific-philosophical) perspectives, e.g., the positivist, the interpretive or the critical (cf. W. Chua [7]). The Chua's three perspectives were used in some literature reviews (Orlikowski and Baroudi [34], Chen and Hirschheim [5] and Richardson and Robinson [36]), and Iivari ([21-22]) used them in his paradigmatic analyses of both contemporary schools of IS development and Information Systems as a design science. The world views have an influence on modeling of the initial states and maybe on the desired states, too. We shall show that the assumptions on human being and human society based on those three world views or perspectives are different and will lead to different goodness criteria. Concerning the new IT artifact we shall refer to Reeves and Bednar [35] who show that managers often emphasize value of output, designers stress on conformance of output to specifications and customers wish that the output meets and/or exceeds their expectations. We are not aware of any paper that has described all the perspectives in one and the same paper.

March and Smith [29] and Hevner et al. [20] were mainly interested in IT artifacts. But there are also other innovations than technical ones, for example, social innovations. A new information system is a socio-technical system, not only the IT artifact alone but also people who use that IT artifact. Hence the goodness evaluation of the IT artifact gives different results from the evaluation of the whole information system consisting both the IT artifact and users. Moreover, a development of a certain social innovation is not as easy as technical ones, and it requires a special attention.

The rest of this paper is structured as follows: In Section 2 we shall analyze models as the design research output and we shall propose some goodness criteria from the three different perspectives (positivist, interpretive and critical). In Section 3 we shall consider the different stake holder groups of the design process and output of an IT instantiation and propose some goodness criteria for them. We shall also analyze special characteristics of a social innovation and its development process. Finally we shall summarize the results of our analysis and assess their merits and limitations.

2 Goodness Criteria of Models from the Different Perspectives

A researcher can approach a reality by taking different assumptions on the world as a starting point. We shall here use three perspectives: The positivist, the interpretive and the critical that describe the world views implicitly or explicitly.

According to Chua [7:611], the ***positivist*** researcher assumes that "empirical reality is objective and external to the subject. Human beings are also characterized as passive objects; not seen as makers of social reality". Chua continues as follows: "People are analyzed as entities that may be passively described in objective ways

(for example as information-processing mechanisms or as possessing certain leadership or budgetary styles)." [7:606]. Chua defines that "theory is separate from observations that may be used to verify or falsify a theory. Hypothetico-deductive account of scientific explanation accepted." March and Smith [29:261] say the similar as more detail: "Models are evaluated in terms of their fidelity with real world phenomena, completeness, level of detail, robustness, and internal consistency." We choose those into our table below. We supplement Table 1 with the criteria presented by Straub et al. [37] and mainly intended to the construct level: content validity, construct validity, reliability, manipulation validity, and statistical conclusion validity. Straub et al. [37] concentrate on validity and refer to Nunnally [33:383] that "the purpose of validation is to give researchers, their peers, and society as a whole a high degree of confidence that positivist methods being selected are useful in the quest for scientific truth.". Straub et al. [37] give recommendations how to proceed in validation and checking: 1) Instrument is likely measuring the right content; 2) Constructs are likely real and reliable; 3) Rival hypotheses are ruled out, and 4) Mathematical relationships between the constructs are assured within certain degrees of confidence.

Table 1. Some criteria for positivist research

Model level
Fidelity with real world phenomena,
Completeness,
Level of detail,
Robustness
Internal consistency
Manipulation validity
Statistical conclusion validity
Construct level
Content validity
Construct validity
Reliability

We understand that verification of a certain theory in the sense of Chua means that the theory shows "fidelity with real world phenomena". Such criteria as completeness and level of detail mentioned by March and Smith measure how closely the theory is describing the object under study. Robustness and internal consistency refer to some internal properties of the theory. Two criteria proposed by Straub et al. [37], manipulation validity (a measure of the extent to which treatments have been perceived by the subjects of an experiment) and statistical conclusion validity (Type of validity that addresses whether appropriate statistics were used in calculations that were performed to draw conclusions about the population of interest) concern a actual reality and its measurements not the planned reality in the future and they are intended to verification of a certain theory in the sense of Chua. Three other criteria proposed by Straub et al. [37] (content validity, construct validity and reliability) concern validation of the instruments that are used to gather data on which findings and interpretations are based.

Concerning three types of models in design research (1) a model of the initial state, 2) a model of the desired state and 3) the model of the finished, realized state) from the positivist perspective, we can say that all the three models can be described. The initial and finished states refer to actual reality, but the desired state to potential reality. The latter brings two important remarks. First, an exceptional assumption is that there is consensus concerning the desired state. Second, a certain steady state concerning people must be assumed, although people can learn and forget, and Chua's assumptions on people are not hence quite realistic.

According to Chua [7:615], the ***interpretivist*** researcher assumes that "social reality is emergent, subjectively created, and objectified through human interaction". Chua also gives some criteria for models: "Scientific explanations of human intention sought. Their adequacy is assessed via the criteria of logical consistency, subjective interpretation, and agreement with actors' common-sense interpretation."

Klein and Myers [27:72] proposed seven principles for interpretive field research (see Table 2).

Table 2. Summary of principles for interpretive field research

1. The Fundamental Principle of the Hermeneutic Circle This principle suggests that all human understanding is achieved by iterating between considering the interdependent meaning of parts and the whole that they form. This principle of human understanding is fundamental to all the other principles.
2. The Principle of Contextualization Requires critical reflection of the social and historical background of the research setting, so that the intended audience can see how the current situation under investigation emerged.
3. The Principle of Interaction between the Researchers and the Subjects Requires critical reflection on how the research materials (or "data") were socially constructed through the interaction between the researchers and participants.
4. The Principle of Abstraction and Generalization Requires relating the ideographic details revealed by the data interpretation through the application of principles one and two to theoretical, general concepts that describe the nature of human understanding and social action.
5. The Principle of Dialogical Reasoning Requires sensitivity to possible contradictions between the theoretical preconceptions guiding the research design and actual findings ("the story which the data tell") with subsequent cycles of revision.
6. The Principle of Multiple Interpretations Requires sensitivity to possible differences in interpretations among the participants as are typically expressed in multiple narratives or stories of the same sequence of events under study. Similar to multiple witness accounts even if all tell it as they saw it.
7. The Principle of Suspicion Requires sensitivity to possible "biases" and systematic "distortions" in the narratives collected from the participants.

Klein and Myers suggest that the principle of the hermeneutic circle is the overarching principle upon which the other six principles expand. For instance, a researcher's deciding on what relevant context(s) should be explored (principle two) depends upon the following: how the researcher "creates data" in interaction with the subjects (principle three); the theory or concepts to which the researcher will be abstracting and generalizing (principle four); the researcher's own intellectual history (principle five); the different versions of "the story" the research unearths (principle six); and the aspects of the "reality presented" that he or she questions critically (principle seven).

Chua's criterion logical consistency refers to the internal properties of the theory and Principle 7 is mostly supporting this Chua's view. Principle 3 is given with the same purpose as Chua's two other criteria (subjective interpretation, and agreement with actors' common-sense interpretation). The other principles 1, 2, 4, 5 and 6 are intended to guide the research process from the interpretive perspective.

Concerning three types of models in design research (1) a model of the initial state, 2) a model of the desired state and 3) the model of the finished, realized state) from the interpretive perspective, we can say that all the three models can be described but it takes time. The reason for the long time requirement is based on the Chua's assumptions on subjective interpretation, and agreement with actors' common-sense interpretation. All the participants and the researcher must have the common views on both the initial, desired and finished states and developing those views requires negotiations and discussions and it takes time.

According to Chua [7:622], the ***critical*** researcher assumes that "human beings have inner potentialities which are alienated (prevented from full emergence) through restrictive mechanisms. Objects can only be understood through a study of their historical development and change within the totality of relations." Chua continues that "criteria for judging [critical] theories are temporal and context-bound" [7:622).

Myers and Klein prepared an important paper with six principles of critical research (see Table 3). The authors cautiously express that their proposals are only applicable to when using one of the three critical streams or theories (Bourdieu [1-3], Foucault [10-13], Habermas [14-18].

When Chua claims that human beings have inner potentialities, Myers and Klein in their Principle 4 emphasize individual emancipation. In Principle 5 Myers and Klein refer to current forms of domination and Chua writes about restrictive mechanisms. Already Principle 3 speaks about revealing and challenging prevailing beliefs and social practices. Principles 1 and 2 guide the research process, and Principle 6 in a nice way underlines improvements in social theories.

Concerning three types of models in design research (1) a model of the initial state, 2) a model of the desired state and 3) the model of the finished, realized state) from the critical perspective, we can find many difficulties. Depending on different interested parties they can have different views on what is bad and what is good in the initial state. Describing the model of the initial state can hence be difficult or impossible. But finding the desired state is even much more difficult, because the different groups prefer different things. Mumford [31] in her historical consideration of socio-technical design found that a humanistic set of principles aimed at increasing

Table 3. A proposed set of principles for critical research (Myers and Klein [32:25])

The Element of Critique
1. The principle of using core concepts from critical social theorists This principle suggests that critical researchers should organize their data collection and analysis around core concepts and ideas from one or more critical theorists.
2. The principle of taking a value position Critical theorists advocate values such as open democracy, equal opportunity, or discursive ethics. These values drive or provide the basis for principles 4 through 6.
3. The principle of revealing and challenging prevailing beliefs and social practices This principle suggests that critical researchers should identify important beliefs and social practices and challenge them with potentially conflicting arguments and evidence.
The Element of Transformation
4. The principle of individual emancipation All critical social theory is oriented toward facilitating the realization of human needs and potential, critical self reflection, and associated self-transformation.
5. The principle of improvements in society This principle suggests that improvements in society are possible. The goal is not just to reveal the current forms of domination, but to *suggest* how unwarranted uses of power might be overcome (although the critical theorist should not assume any special position of authority). Most critical theorists assume that social improvements are possible, although to very differing degrees.
6. The principle of improvements in social theories All critical theorists believe that our theories are fallible and that improvements in social theories are possible. Critical researchers entertain the possibility of competing truth claims arising from alternative theoretical categories, which can guide critical researchers in their analyses and interventions.

human knowledge while improving practice in work situations. Evolution of socio-technical design in the 1960s and 1970s evidencing improved working practices and joint agreements between workers and management are contrasted with the much harsher economic climate of the 1980s and 1990s. We here also refer to the next section and especially to the Iveroth's [24] method to solve resistance of change.

3 Some Stakeholder Groups and Their Goodness Criteria on IT Instantiations

In this section we first present some universal criteria and guidelines of an IT instantiation. Concerning IT artifact and its design there are many interested parties that emphasize different aspects. Hence we shall consider different stake holder groups and their criteria. IT artifact rarely functions alone but some changes in user behavior are necessarily needed when a new IT system is implemented. The Iveroth [24] approach on introduction of a new information system is thereafter presented.

3.1 Universal Criteria and Guidelines

We use March and Smith's [29:258] definition: "An *instantiation* is the realization of an artifact in its environment" and consider an instantiation as product whose quality

can be evaluated. They also defined some universal criteria for an IT artifact: the efficiency and effectiveness of the artifact, and its impacts on the environment and its users. Hevner et al. [20] followed the similar idea as Klein and Myers [27] and proposed the seven guidelines for design research.

The *guidelines* Hevner et al. [20:82] present below are adaptive and process-oriented. "Design science is inherently a problem solving process. … Design-science research requires the creation of an innovative, purposeful artifact (Guideline 1) for a specified problem domain (Guideline 2). Because the artifact is *purposeful*, it must yield utility for the specified problem. Hence, thorough evaluation of the artifact is crucial (Guideline 3). Novelty is similarly crucial since the artifact must be *innovative*, solving heretofore unsolved problem or solving a known problem in a more effective or efficient manner (Guideline 4). In this way, design-science research is differentiated from the practice of design. The artifact itself must be rigorously defined, formally represented, coherent, and internally consistent (Guideline 5).The process by which it is created, and often the artifact itself, incorporates or enables a search process whereby a problem space is constructed and a mechanism posed or enacted to find an effective solution (Guideline 6). Finally, the results of the design-science research must be communicated effectively (Guideline 7) both to a technical audience (researchers who will extend them and practitioners who will implement them) and to a managerial audience (researchers who will study them in context and practitioners who will decide if they should be implemented within their organizations). Table 4 summarizes the seven guidelines."

We pay attention to Guideline 2 where it says that "the objective of design-science research is to develop technology-based solutions to important and relevant business problems". Hevner et al. consciously restrict their innovation into technology,

Table 4. Design-science research guidelines

Guideline	Description
Guideline 1: Design as an artifact	Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.
Guideline 2: Problem relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.
Guideline 5: Research rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
Guideline 6: Design as a search process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

especially IT technology and people using that IT artifact are excluded from their consideration. The evaluation of a design artifact then concerns the IT artifact only. We shall return to this view later in connection with Iveroth's [24] approach.

3.2 The Three Stakeholder Groups

According to Reeves and Bednar [35:427] "an essential building block for theory development about quality is an understanding of extant definitions and their origins. Different definitions of quality have been proposed at various times in response to the evolving and constantly changing demands of business. New definitions have not replaced old definitions; rather, all of the quality definitions continue to be used today." They found many definitions of quality, but the following ones were much distinguishing: Excellence, value, conformance to specifications and meeting and/or exceeding expectations. To clarify those four expressions we cite their strengths as Reeves and Bednar [35:437] presented them. The strengths of *excellence* are: Strong marketing and human resource benefits, universally recognizable - mark of uncompromising standards and high achievement. The strengths of *value* are: Concept of value incorporates multiple attributes, focuses attention on a firm's internal efficiency and external effectiveness, and allows for comparisons across disparate objects and experiences. The strengths of *conformance to specifications* are: Facilitates precise measurement, leads to increased efficiency, necessary for global strategy, should force disaggregation of consumer needs, and most parsimonious and appropriate definition for some customers. The strengths of *meeting and/or exceeding expectations* are: Evaluates from customer's perspective, applicable across industries, responsive to market changes, and all-encompassing definition.

Those characterizations given above will lead us to interpret that excellence is an overall measurement criterion that could correspond to our earlier proposal [26] called the *goal function* under which all kinds of different interests can be collected. The goal function is a goodness criterion of a new system. In addition, we think that the *managers* could emphasize value as a goodness criterion of a new system or artifact, *designers* would underline conformance of a new system to specifications, and *customers* might aim that a new system will meet and/or exceed their expectations. Hence there is no one criterion for a new IT artifact or the new information system, but different stake holder groups prefer different evaluation criteria.

3.3 The Iveroth [24] Approach

Hevner et al. [20:84] argue that "a combination of technology-based artifacts (e.g., system conceptualizations and representations, practices, technical capabilities, interfaces, etc.) organization-based artifacts (e.g., structures, compensation, reporting relationships, social systems, etc.), and people-based artifacts (e.g., training, consensus building, etc.) are necessary to address issues concerning the acceptance of information technology in organizations". Referring to Henderson and Venkatraman [19] Hevner et al. [20:78] state that "the effective transition of strategy into infrastructure requires extensive design activity on organizational design to create an

effective organizational infrastructure and information systems design activity to create an effective information system infrastructure. These are interdependent design activities that are central to IS discipline." Although such tight connections exist between those two activities Hevner et al. limited their discussion of design science to activities of building the IS infrastructure within the business organization.

We can say that the range, the new IT artifact, taken by Hevner et al. [20] for accounting costs and benefits was too narrow (cf. Virkkunen [40]). Iveroth [24:136] crystallizes the reason as follows: "Research tells us that one of the major reasons for this is that managers treat IT as an isolated and mechanical tool that is and should be set aside and managed by the IT department. The underlying principle in this is that once the 'IT people' unleash the new technology, change spreads throughout the organization and employees simply and automatically adapt to the new circumstances. In short, managers often think that IT will take care of itself once it is implemented. What they tend to forget, however, is that IT is intimately interlinked with the organization and the way people go about their daily work. As a result, successful IT-enabled change implies managing both the IT itself *and* its social and organizational implications."

Iveroth [24:137] carefully summarized the success factors of the IT-enabled change projects that did not failed and tried "to find out how managers in practice lead global IT-enabled change, and what their activities and roles are in such work." (See Table 5) We agree with one of referees who writes that "many other IS researchers have done that as well". We picked up Iveroth's approach because, to our mind, Iveroth has collected many of the most promising ideas for change management and built the approach that seems to be efficient. Hence, Iveroth can be here considered as an example of many other similar approaches.

Table 5. The commonality framework for IT-enabled change (Iveroth [24:140]

Change Dimension	**Change Activity**	**Role of Change Agent**
Common Ground	Transactional activities such as the transfer of a change message between change agent and change recipient.	Messenger
Common Meaning	Translational activities aimed at overcoming interpretive differences between actors through learning and reflection.	Expert and Translator
Common Interest	Relational activities, both political and supportive nature. The political activities align interests by negotiations and informal relationships, and the supportive activities manage feelings and emotions, and motivate change recipients.	Negotiator and Coach
Common Behavior	Stabilizing activities—consisting of monitoring, communicating, and intervening actions—which secure long-term and recurrent behavior aligned to the new IT.	Observer and Intervener

We repeat that Table 5 shows activities for managers and change agents, and the activities proposed are taken from the managers' point of view. By looking at Table 5 and its activities we become to the following conclusions: a) The new IT system contains both technical and social components, b) Those two components behave

differently – the technical one regularly but the social one unpredictably, c) The range for accounting the costs and benefits of the new IT system is now larger than in the case described by Hevner et al. [20], and d) the activities in Table 5 can be said to form a manager-driven social innovation.

In our approach to design research [25], in addition to the technical innovation, e.g., IT artifact, we have taken two other innovations based on two other resource types, social and informational innovations. Case Ericsson described by Iveroth [24] is a combined innovation consisting of both technical and social components.

Korpelainen et al. [28] found another social innovation when they studied a global company that purchased an ICT system, an internet-based meeting system, for training their customers. But customers had difficulties to connect with that system, and hence the system was given for internal use in the company. People in the company started to voluntarily use the system. Korpelainen et al. "show that the self-determined adoption of ICT systems has benefits like user motivation and satisfaction. Problems in such adoption relate to users' experiencing uncertainty regarding the organizational legitimization of the system and support for its use. Employees and organizations are likely to benefit from self-determined adoption because it promotes employees' motivation and initiative-taking. However, a shared understanding of self-determination and organizational support for it are required" [28:51]. Our reason to pick up the Korpelainen et al.'s finding is that it shows the distributed group of professionals voluntarily created a social innovation around a certain technical system originally intended to other purposes.

4 Discussion

Constantinides et al. [9] propose a pragmatic framework for ends of Information Systems research. This framework can be kept as the challenger of our results. The framework is presented in a tabular form consisting of 4 columns (logic, ethics, aesthetics, and the highest good) and 3 rows (before, during and after a study), and the ends are conditioned by power relations. Although the pragmatic framework seems to be very promising, one approach (experimental research) only is still analyzed and many others are lacking. Constantinides et al. [9] emphasize the truth only and they seem to forget utility and hence design research. In addition, our sets of criteria and guidelines contain at most the magical number seven [30] but the example table for the ends of experimental research shown by Constantinides et al. [9] contains 12 -15 entries. To this end, the pragmatic framework is not yet better than our collection of goodness criteria and guidelines.

In design research there are both the truth-seeking and utility-seeking studies. The former, e.g., models creating studies, can have different starting points, different world views and perspectives and hence different criteria. In the utility-seeking studies, there are different stake holder groups with different criteria, there are also different innovation types and different criteria, and the different ranges for accounting and hence different criteria. All the examples and references used show

that they are already known but the scientific merit of this paper is that they are here collected into one presentation and structured in a new way.

Researchers can follow the criteria presented when they perform their research projects. In connection with our consideration of the world views we many times showed how problematic is that computers and data behave regularly but people unpredictably. Moreover, people construct social reality. Referees and editors can use the criteria collected when they evaluate the submitted papers. Evaluation can sometimes be problematic if the world view is only implicitly taken, not explicitly presented.

As we know our differentiation of the three types of models in design research (1. a model of the initial state, 2. a model of the desired state and 3. the model of the finished, realized state) is new, and their consideration in connection with the three world views (positivist, interpretive and critical) is also novel.

We know some limitations of our paper. We informed that an informational innovation can exist, but in the literature there are very few such innovations reported, perhaps Christiaanse and Venkatraman [8] where information asymmetry was utilized is one of those. In design research there are also other purposes than utility, like pleasure (van der Heijden [39]), and to artisticize and accompany (Iivari [22]). C. Chua et al. [6] found more stake holder types, e.g., supplier, investor, regulator, competitor etc., than Reeves and Bednar [35]. In addition to product also services where a customer can participate in creation process of service can be taken into account when criteria for new innovations are studied. In social innovations, e.g., for the competence development, such criteria can be proposed as our functionality, sensitivity and sociality (Illeris [23:438]. In the beginning we excluded both constructs and methods outside of our study, because they would increase many fold the volume of this study. All the limitations mentioned must be carefully studied in the future.

In connection with their validity considerations Straub et al. [37] ask: “How would one know which validation principles make sense, both on an individual basis and on the basis of the field as a whole? The social sciences tend to develop validation principles concurrent with the pursuit of research. ... Ironically, though, this question cannot be answered simply because scientific methods and techniques cannot themselves be used to validate the principles upon which they are based. Scientific principles for practice are only accepted as received wisdom by a field or profession through philosophical disputation (Nunnally [33]). Over time, they become accepted norms of conduct by the community of practice.” The citation above well describes the role of criteria and guidelines presented. They are tentative proposals to give researchers, reviewers, donators, etc. for a while; some of them are accepted and some are improved by the community of practice and knowledge.

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